ANNUAL REPORT
1990-1991

THE ENERGY OF OUR RESOURCES

THE POWER OF OUR IDEAS

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CANMET
Canada Centre for Mineral and Energy Technology
Centre canadien de la technologie des minéraux et de l'énergie

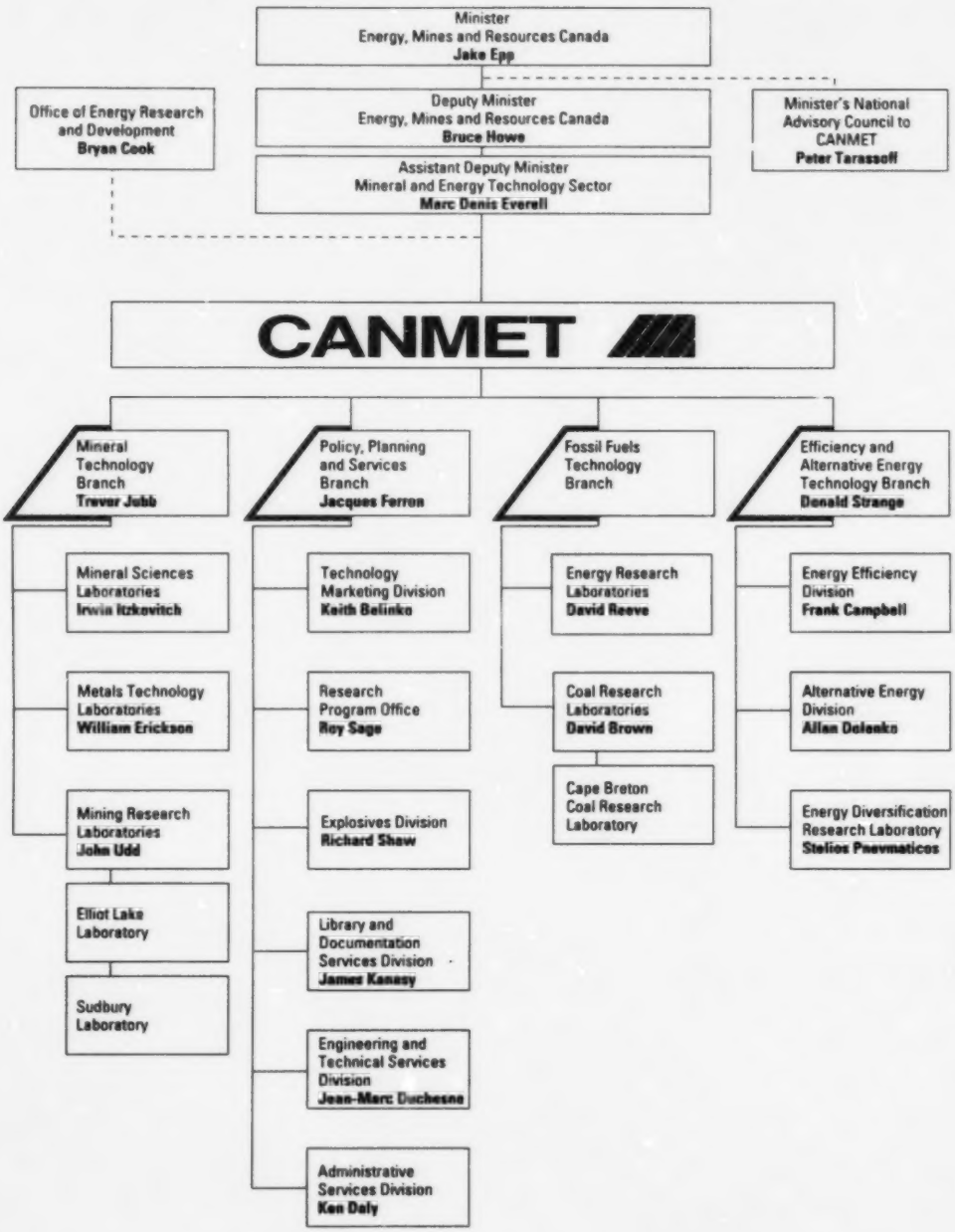
CANMET (Canada Centre for Mineral and Energy Technology) is the main research and technology development arm of Energy, Mines and Resources Canada (EMR). Through its six laboratory groups, CANMET works to find safer, cleaner and more efficient methods to develop and use Canada's mineral and energy resources.

In partnership with its clients, CANMET performs and sponsors predominantly commercial and cost-shared research and development, and technology transfer, with the following mandate:

- to enhance the competitiveness of the Canadian minerals, metals and energy industries;
- to improve and develop energy efficiency and alternative energy technologies;
- to improve health, safety and environmental control in the client industries; and
- to support government policy initiatives.

CANMET serves the minerals, metals and energy industries across Canada through its research facilities in Nova Scotia, Quebec, Alberta, the National Capital Region and Northern Ontario, and its regional office in British Columbia.

ORGANIZATION



FOREWORD

In the past year, a number of new CANMET initiatives have been conducted in support of the Government of Canada's priorities for the country's prosperity in economic and environmental terms. CANMET recognizes that Canada's continued economic and social well-being depends on the efficient development and use of our mineral and energy resources. The Centre continues to look ahead in its development and support of science and technology to help maintain the competitiveness of Canadian industry at home and abroad.

Competitiveness and Prosperity Through Partnerships

CANMET's major objectives during the past year included increasing the number of joint projects with industry, licences, invention disclosures, staff exchanges with the private sector, and technology transfer conferences and workshops. Substantial progress has been made in these areas.

For example, CANMET signed more than 400 agreements with industry and other research organizations throughout Canada for collaboration on R&D. In cooperation with industry, CANMET has also sponsored nearly 40 conferences, seminars and workshops across the country to transfer technologies to the private sector.

Increasing the competitive abilities and the productivity of Canadian industry to stimulate prosperity requires the collaborative efforts of governments and industry. CANMET's initiatives, many of which are highlighted in this report, demonstrate the Centre's commitment to work in partnership with industry and other research organizations for the greater benefit of Canada.

To help meet the needs of the Canadian mining industry, a new national facility is being established in Val d'Or, Quebec. Research will be dedicated to areas such as narrow vein mining, rock fragmentation, automation technologies and robotics – all of wide interest to the Canadian mining industry. Other CANMET initiatives in the area of mining, specifically health and safety, are contained in this report.

CANMET's Commitment to the Environment

CANMET also recognizes the importance of protecting and preserving the environment, and the Centre has increased its efforts to develop technologies to prevent water and air pollution, control global warming, and technologies for the treatment and reduction of wastes. To this extent, the Centre expects to play a significant role in the implementation of the Government of Canada's Green Plan.

The Centre's environmental efforts have been highlighted in an information package entitled *CANMET and the Environment*. A section of this report is dedicated to an overview of our research which has achieved positive environmental results

without adversely affecting Canada's potential for economic prosperity.

Integrated energy systems have been identified by CANMET as a key component in the efficient use of Canada's energy resources. This year, the Energy Systems Technology Implementation Group was established to communicate the concept and benefits of integrated energy planning across Canada to both industry and the public.

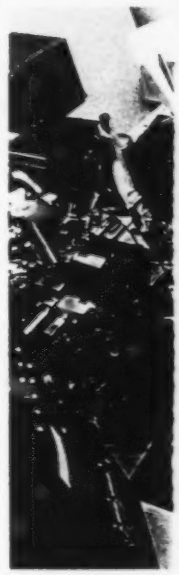
Following last year's integration of the Efficiency and Alternative Energy Technology Branch into CANMET, a new technical committee of the Minister's National Advisory Council to CANMET (MNACC) was formed. The Efficiency and Alternative Energy Committee is chaired by Alan Pelman, President and Chief Executive Officer of Powertech Labs Inc.

Under the umbrella of MNACC, a committee led by Réal L'Archevêque, Vice-President, Research and Technology, The SNC Group Inc., has provided guidance in setting the research priorities of the new Energy Diversification Research Laboratory located in Varennes, Quebec. Construction of the facility is expected to begin in the fall of 1991.

CANMET's presence at both the national and regional levels ensures an excellent understanding of the many different needs of Canadian industry. Current efforts to modernize and restructure the Public Service of Canada and the recommendations of the Lortie Committee of the National Advisory Board on Science and Technology have given CANMET an opportunity to request the authority to implement a new managerial framework. This new structure would give CANMET more flexibility to conduct business in a more responsive framework.

As a final note, CANMET congratulates Engine Control Systems Ltd. (ECS) of Newmarket, Ontario, for winning the Gold Medal in the environmental category of the 1990 Awards for Business Excellence, sponsored by Industry, Science and Technology Canada. ECS is currently marketing a pollution-abating ceramic filter for diesel engines which was originally developed at CANMET laboratories.

We invite you to review the successes that CANMET has achieved in partnership with its clients across Canada. Any comments on this report or questions regarding CANMET's programs are most welcome.



MARC DENIS EVERELL
Assistant Deputy Minister
Mineral and Energy Technology Sector

COMMERCIAL VENTURES

CANMET licenses new technologies to industry for commercialization.

A major CANMET objective is to transfer to the private sector technologies, products and concepts developed by the Centre for the minerals, metals and energy industries. During the year, many CANMET technologies were transferred to industry through licences.

In 1990, CANMET licensed 15 of its COMPUTER-AIDED MINERAL PROCESSING (CAMP) SOFTWARE PACKAGES. The software, which streamlines ore dressing, has applications in sampling and material-balance computation, modelling, process simulation and laboratory calculations.

Corrigan Instrumentation Limited received a licence from CANMET to commercialize the TOTAL CYANIDE ANALYZER. The equipment was developed by CANMET for use in the automated analysis of low levels of cyanide in liquid industrial effluent (for environmental applications), or in liquids used during mineral processing. The new automated analysis has a throughput of ten samples per hour, or five times that of manual analysis. Accuracy of the Analyzer is equivalent to, or better than, that of the manual method.

National Vacuum Technologies Inc. was licensed to commercialize the VACUUM TRANSFER VESSEL TECHNOLOGY developed by CANMET in cooperation with McMaster University. The portable equipment enables the transfer of solid samples without air exposure from one location to another for chemical analysis. The device is expected to have applications in many fields, including medicine and forensic science.

CANMET granted a licence to the University of British Columbia to market its software package, SECRETION FORMATION IN SUBMERGED INJECTION PROCESSES. The software predicts performance for any kind of gas stream injected under liquid metals. The package will have widespread applications in the metallurgical industry – for example, in copper converters and electric arc furnaces for melting steel. The software was developed under contract by the University in collaboration with Canadian Liquid Air.

Alcan Aluminium Limited received a licence for the CANMET METAL SEPARATOR developed by CANMET during research sponsored by Alcan. The technique has been effective in the economical recovery of aluminum from used potliners (employed during aluminum production) and also has application in the recycling of aluminum cans.

Advanced Scientific Computing Ltd. (ASCL) has received a licence from CANMET to use a TWO-DIMENSIONAL COMBUSTION SOFTWARE MODEL for in-house purposes and to market a THREE-DIMENSIONAL version of the model developed by ASCL for CANMET under contract. The software simulates the fluid flow, chemical reaction and heat transfer in any combustion process. The program can then be used to improve the efficiency of an existing process or in the design of a new combustor – for example, a large utility boiler.

Two licences were granted to Inco Limited to apply and market technologies developed by Inco under contracts with CANMET and funded by the Canada/Manitoba Mineral Development Agreement. One licence is for a software package which will assist in OPTIMIZING THE BLAST DESIGN FOR UNDERGROUND BLASTHOLE MINING OPERATIONS. The other licence involves know-how related to mineral processing techniques aimed at the REDUCTION OF SULPHUR EMISSIONS from an Inco smelter. This knowledge may have applications at other smelters and will assist in efforts to reduce emissions linked to acid rain.

PATENTS GRANTED TO CANMET

The following patents registered in 1990-91 are for technologies developed by, or collaborated on, by CANMET.

INVENTION	INVENTORS	PLACE OF WORK	COUNTRY
CONVERSION OF METHANE TO GASOLINE-RANGE HYDROCARBONS VIA ISOBUTENE: an improved process for synthesizing gasoline from natural gas.	Vincenza Allenger Raj Pandy	CANMET Guelph Chemical Laboratories Ltd.	United States
HYDROCRACKING OF HEAVY OIL IN THE PRESENCE OF ULTRAFINE IRON SULPHATE*: a hydroconversion process for heavy hydrocarbon oil that converts a portion of it to lower-boiling products.	Keith Belinko Chandra Khulbe Anil Jain	CANMET Petro-Canada Inc. Petro-Canada Inc.	United States
MEMBRANE PROCESS FOR SEPARATING METHANOL FROM METHANOL/HYDROCARBON SOLUTIONS: a separation process that utilizes reverse osmosis for the selective removal of methanol from hydrocarbon solutions.	Brian Farnand Henry Sawatzky	CANMET CANMET	Canada
SIMULTANEOUS HYDROCRACKING OR COPROCESSING OF 525°C PETROLEUM PITCH/COAL SLURRIES: a process for coprocessing of heavy hydrocarbon oils, such as bitumen from tar sands.	Safaa Fouda James Kelly	CANMET CANMET	Canada
BOREHOLE STRAIN MONITOR FOR SOFT ROCK: an instrument to measure radial deformation of boreholes in weak rock to determine the strain exerted by surrounding masses.	Gerhard Herget Frank Kapeller	CANMET CANMET	Canada

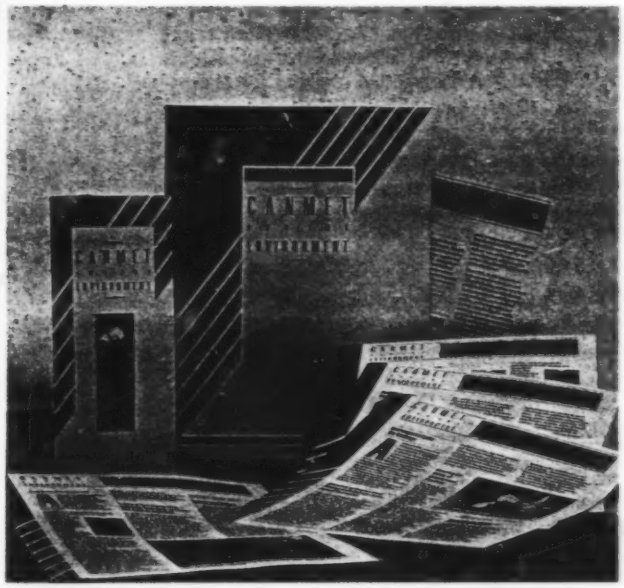
* Petro-Canada holds patent.

INVENTION	INVENTORS	PLACE OF WORK	COUNTRY
FLASH HYDROPYROLYSIS OF BITUMINOUS COAL: an improved system whereby agglomeration and caking of high-ranking coal is prevented during flash pyrolysis.	Michio Ikura Anthony Last	CANMET Process Wave Energy Consulting Inc.	United States
SYSTEM FOR ASH REINJECTION IN BUBBLING-BED FLUIDIZED BED COMBUSTOR: an improved system for reinjecting solid particles removed from flue gases into the combustion zone of a bubbling bed.	Vladimir Razbin Dilip Desai Frank Friedrich	CANMET CANMET CANMET	Canada
PROCESS FOR PREPARING AN IRON-COAL SLURRY CATALYST FOR HYDROCRACKING OF HEAVY OIL*: a method that utilizes an improved iron-coal catalyst for hydroconversion of heavy hydrocarbon oil.	Chandra Khulbe Keith Belinko Richard Waugh Michel Perrault	Petro-Canada Inc. CANMET Petro-Canada Inc. Petro-Canada Inc.	United States
TWO-STAGE COPROCESSING OF BITUMEN/COAL SLURRIES: a process to suppress coke formation and to increase lighter distillates in coal/oil coprocessing.	Michio Ikura James Kelly	CANMET CANMET	Canada
COAL AGGLOMERATION BENEFICIATION WITH HEAVY HYDROCARBON OILS AND UTILIZATION THEREOF IN COAL/HEAVY OIL COPROCESSING: a process for removing ash from coal before it is mixed with bitumen as a feedstock for coal/oil coprocessing.	Josef Mikhlin Michio Ikura James Kelly C. Edward Capes	(Deceased) CANMET CANMET National Research Council Canada	Canada

* Petro-Canada holds patent.

CANMET AND THE ENVIRONMENT

As part of its role to conduct and sponsor research and development in support of Canada's minerals, metals and energy industries, CANMET is also committed to helping these industries to be environmentally conscious. When developing new technologies, CANMET ensures that the possible impact on the environment is taken into account.



During the year, an information package entitled *CANMET and the Environment* was produced. The package describes the various areas of environmental concern and some of CANMET's initiatives in dealing with such matters as the prevention of environmental spills, waste management, air and water pollution abatement and the reduction of greenhouse gases.

In its efforts to reduce air pollution, for example, CANMET has been developing and improving technologies to reduce harmful emissions through research for alternative transportation fuels. Fuels, such as propane, natural gas, methanol and ethanol, are considered excellent alternatives to gasoline and diesel since they have proven to be clean and safe, and vehicles powered by these fuels release fewer harmful emissions of carbon dioxide, carbon monoxide and reactive hydrocarbons. A CANMET-sponsored program in which transit buses fuelled with methanol are being operated in Winnipeg, Manitoba and Medicine Hat, Alberta is also being evaluated to compare the use of methanol with other fuels.

In collaboration with a large number of industries and other governments throughout North America, CANMET has participated in a program whereby Canadian and American students were invited to compete in developing new technology for vehicles using natural gas and methanol. In support of these programs, called the Methanol Challenge and the Natural Gas for Vehicles (NGV) Student Challenge, General Motors donated 15 Corsicas for the Methanol Challenge and 24 half-ton pickup trucks for the NGV Student Challenge to the participating universities. As part of the Methanol Challenge, the Honourable Jake Epp, Minister of Energy, Mines and Resources, officiated at a ceremony to send the cars on a 200-mile rally to Ann Arbor, Michigan, where emissions, fuel economy and performance tests were conducted. CANMET also supported three Canadian university teams in developing photovoltaic cars to participate in two separate international competitions.

CANMET continued to be a major participant in the Mine Environment Neutral Drainage (MEND) Program in collaboration with 15 Canadian mining companies, Environment Canada, Indian and Northern Affairs Canada and the provinces of British Columbia, Manitoba, Ontario, Quebec and New Brunswick. This Program was established to develop technologies to prevent and control acidic drainage. Activities include the development of improved methods for predicting and modelling acid generation from wastes containing sulphides, the evaluation of various technologies to reduce or prevent the weathering of tailings, and the application of biological and other processes for treating acidic drainage, capturing heavy metals and stabilizing sludges from existing lime plants.

As a research organization, CANMET plays a significant role in developing, supporting and promoting technologies to help control global warming through energy conservation and efficiency. CANMET is therefore committed to promoting research on alternative sources of energy such as solar heating, photovoltaic and wind energy, and small-scale hydro. CANMET's research capability related to heat upgrading, energy storage, natural gas utilization and renewable energy technologies will be expanded through its new Energy Diversification Research Laboratory which is being established in Varennes, Quebec.

Disposal of waste foundry sands continues to be a problem for the foundry industry. These sands must be disposed of in approved landfill at considerable cost, although some sands may be used as road bed filler. However, it would be preferable to reclaim the sand for reuse in the foundry. Thus, CANMET has participated in a Canadian Foundry Association Sand Reclamation Committee which has reviewed North American equipment for reclaiming green sand to core sand quality. In May 1989, the committee travelled to Europe on a technology assessment mission to investigate sand reclamation plants, and went to Japan in September 1990 where Japanese companies are reclaiming mixtures of sand. The goal of this project is to ensure that the best possible economically viable technology for recycling foundry sand is available in Canada.

More examples of CANMET's research and development projects on the environment are detailed in the following sections.

HEALTH AND SAFETY

A major component of CANMET's mandate is to assist Canadian industry in improving health and safety. Much of CANMET's work in this area is done in close collaboration with the mining, utility and explosives industries.

During the year, CANMET concentrated its research and development projects associated with this goal on new mining technologies, mine structure stability, mine air pollutant monitoring, automated ventilation control and explosives safety.

CANMET is contributing to the general safety of Canadian mining through the continued development of numerical models, analytical methods, research data and software programs. These provide analyses of the stability of mine structures during various phases of the mining process. New technologies arising from this ongoing research are continually being transferred by licence agreements to industry for use in ground control and improved mine design. In this area, a major initiative undertaken with the provinces and industry is the Canadian Rockburst Research Project, which in 1990 was extended for another five years.

CANMET is also active in safeguarding the mine work environment from such health hazards as diesel soot, radiation and methane gas. Dust and methane gas concentrations are a particular problem in coal mines. In 1990, CANMET collaborated on the first phase of an industry-government program to assess concentrations of diesel soot in the air of underground mines. The objective is to provide guidelines for acceptable concentrations of airborne soot emitted by diesel equipment in these locations.

In the same vein, CANMET's role in the development of tracer gas technology, which is used to solve complex mine ventilation problems and to improve air quality in mines, has attracted international attention. In 1991, the Public Service of Canada presented the CANMET developers with a prestigious Award of Excellence for their work. The technology involves the injection of a non-toxic gas into the air mass of mines to allow downstream analysis of air flow, pollutants, air leaks and recirculation paths. CANMET has been responsible for the development of a tracer gas analyzer, a continuous gas release system, an analysis train and tests of emergency plans and escape routes in the event of mine fires.

CANMET performs testing and research under the *Canada Explosives Act*, and authorizes all new explosives used in Canada, from dynamite to firecrackers. This monitoring has produced high industrial standards as well as a decrease in injuries and deaths related to explosives despite increased use. Another important activity is to improve the safety of manufacturing, storage and transportation of explosives. In addition, during 1990-91, CANMET conducted research in related areas. One project demonstrated that some regular commercial respirators provide protection against toxic fumes emitted from the detonation of explosives. Another effort was launched to enhance the detection of certain explosives, such as those planted by terrorists. In a third project, CANMET is conducting a study of the explosive tendencies of blasting mixtures containing aluminum when these are exposed to fire.

These projects provide a brief overview of the ways in which CANMET is safeguarding the quality of the Canadian work environment. Other examples appear throughout this report.

Joint CANMET-industry research and development projects improve the workplace safety of the Canadian mining and explosives industries.

RESEARCH HIGHLIGHTS

OIL AND GAS

Asphalt from Municipal Sewage

CANMET researchers have identified a novel use for oil derived from sewage sludge as a high-value additive for the asphalt road pavement industry. This can be accomplished by simple modifications to the Oil-From-Sludge (OFS) Process developed by Environment Canada's Wastewater Technology Centre. The project was conducted in collaboration with Environment Canada and ENERSLUDGE INC., the Montréal-based licensee of the process.

The OFS Process is an environmentally safe conversion technology that eliminates the sludge without resorting to incineration or landfilling and produces a liquid hydrocarbon of commercial value. Though the oil has an acceptable heating value as a liquid fuel, CANMET scientists found that its very high nitrogen, sulphur and oxygen content made it attractive in improving the performance of asphalt cement in road pavement. The addition of the liquid hydrocarbon dramatically improves asphalt cement adhesion to the crushed stone aggregate used in road construction. The product also softens and rejuvenates aged asphalt to its original texture so that road pavement can be recycled to extend road life and reduce road replacement costs. ENERSLUDGE is currently marketing the technology package in North America and the Pacific Rim. A 48-tonne-per-day commercial plant is under design for construction in Toronto, Ontario.

Low NO_x Burner

CANMET, in conjunction with the Department of National Defence (DND), demonstrated the use of low nitrogen oxide (NO_x) burners at two DND facilities that combine energy efficiency with NO_x and CO_2 reductions. The project was initiated in recognition of the need for higher

CANMET scientists have successfully demonstrated that oil derived from sewage sludge improves the performance of asphalt cement.

environmental standards on industrial emissions and the pending air emission standards being developed by Environment Canada. The $480 000 price tag is being shared by departments and agencies most affected by the regulations: DND, Corrections Canada, Transport Canada, Agriculture Canada, the Royal Canadian Mounted Police, Canada Post Corporation and Atomic Energy of Canada Limited. CANMET is providing project management, emission and acceptance testing and project evaluation services. An additional $70 000 will be spent over the next year to train government personnel on similar future projects being implemented by their departments.

The advanced technology was installed on boilers at two Canadian Forces bases located in St. Hubert, Quebec, and Halifax, Nova Scotia. Both systems utilize low NO_x burners and flue gas recirculation systems, burning natural gas and No. 2 oil at St. Hubert and No. 6 oil at Halifax. Emission and acceptance tests, conducted in late 1990 at the St. Hubert installation, indicated that proposed Environment Canada emission standards are likely to be met under normal operating practices using the latest technology for natural gas and No. 2 oil. Similar testing is currently being carried out at the Canadian Forces base in Halifax. Results from the project will be used to encourage the further application of this technology to the more than 300 federal government industrial boiler installations across Canada.

Reclaiming Lubrication Oils on Site

With financial support from CANMET's Industry Energy Research and Development Program (IERD), Zimmark Inc., a Canadian company, has developed an on-site reclaiming system for lubrication oils in diesel locomotives that reduces waste, protects the environment and provides significant savings to lube-oil consumers. Previous technologies were uneconomical.The new system is based on a unique clarifier which, with the use of special coagulants, causes oil contaminants to separate from the lubricating oil, leaving the oil clean and suitable for continued use.

Some 900 million litres of lubrication oils are produced in Canada each year. Approximately one half of the oil is consumed in first-time service; however, 80% of the remainder could be reclaimed and used again. Yet, only 37% of these recoverable oils is collected for later use in Canada. This means that some 280 million litres are completely unaccounted for each year. In North America alone, there are 30 railroad systems and hundreds of bus and truck fleets that stand to benefit from this process.

Controlling Bitumen Extraction With Expert Systems

Syncrude Canada Ltd. completed a project to develop the sensors and process control data necessary to regulate bitumen extraction at its Fort McMurray plant in preparation for the implementation of an on-line expert computer system. With CANMET sponsorship, this $2.65-million project received $868 000 in financial assistance from the National Research Council Canada's Industrial Research Assistance Program (IRAP). CANMET provided advice on the selection of an expert system shell and performed research which demonstrated that image analysis can be a viable technique for analyzing the quality of froth – a mixture of bitumen, water and fine solids. The project is one of the most significant IRAP projects sponsored by CANMET to date.

The study focused on characterizing the oil sands and froth and on producing process control information. Significant results included new developments in the use of near-infrared analysis, gamma spectroscopy, image analysis, and microwave absorption techniques for the on-line collection of process data. Experience was also gained in the selection and implementation of expert system shells. All the sensors developed are near commercialization. One expert system has already been implemented and is now in regular use, while a second is under development. Near-infrared techniques have also been applied in the automated analysis of drill cores.

The results of the project will be an important part of future advanced control systems capable of being operated by on-line expert systems. When fully implemented, the system will increase bitumen recovery and improve the reliability of the extraction process.

New Integrated Hydrocracking-Hydrotreating Process

CANMET and Petro-Canada Inc. successfully demonstrated at the pilot scale a new, more cost-effective processing scheme that integrates the primary hydrocracking and secondary hydrotreating processes in the same operation.

Pilot demonstrations of a new integrated hydrocracking process have been successfully completed with CANMET support.

In this integrated scheme, the product vapours from the primary hydrocracking process are fed directly into a catalytic hydrotreating unit operating at the same pressure. In conventional hydrocracking operations, the hydrotreating is decoupled; that is, products from the hydrocracker are separated, cooled and depressurized, then distilled into fractions and hydrotreated in separate units. This requires repressurizing and reheating. The new processing scheme eliminates these steps, resulting in significantly lower capital and operating costs, while still producing a high-quality synthetic crude that can then be refined to finished products.

Near-Infrared Spectroscopy of Tar Sands

In a project sponsored by OSLO, a consortium of oil companies led by Esso Resources Canada Limited, near-infrared (NIR) spectroscopy was used to determine the concentrations of bitumen and solids in a tar sands slurry flowing through a pipeline. A new sampling system, developed by CANMET for this project, proved to be successful. CANMET developed a unique window which can be installed in a pipeline. This window is fabricated from a special material that is abrasion-resistant, prevents fouling and, consequently, allows a continuous reading of the spectra to be taken. Previous measurement methods required a minimum of three hours to complete and could take up to 24 hours for the precision and accuracy that CANMET offered. CANMET's work represents a breakthrough in terms of continuous and rapid on-line measurement of bitumen in tar sand slurries, and clearly demonstrates the applicability and potential of NIR technology. Additional contracts with OSLO are being finalized, and a field-operable system will be ready for installation in the near future.

Oil Sands Sludge Consortium Formed

CANMET and a group of oil companies and organizations* have formed a consortium to investigate the fundamental properties of tailings sludge in the Alberta oil sands. Consortium members are investing $2.5-million-a-year over three years to study the problem. CANMET's contribution will be $770 000. This year, the Centre is also chairing the consortium's technical committee, which is coordinating the research efforts of the organizations involved.

The ultimate objective of the program is to find solutions to the problem posed by the very low settling rate of the sludge in oil sands tailings ponds. These ponds are composed of a sand and clay residue that has accumulated over time as bitumen is extracted from the oil sands. The sludge component is a mixture of water, fine mineral particles and residual bitumen that does not readily settle or consolidate even after many years. There are now some 20 square kilometres of tailings ponds in the Alberta oil sands, and it is estimated that by 1995 over 300 million cubic metres of sludge will have built up in these ponds. Oil sands companies, various research organizations and others have expended considerable effort over the years to find disposal solutions. A better understanding of the fundamentals of sludge formation and sludge properties appears essential before the most technically and economically feasible disposal technology can be developed. By combining their research capabilities, the consortium members hope to find an economical and environmentally sound solution to the problem of sludge disposal.

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* Alberta Energy
Alberta Research Council
Alberta Oil Sands Technology and Research Authority (AOSTRA)
Environment Canada
National Research Council Canada
Syncrude Canada Ltd.
Suncor Inc.

CANMET Designs Innovative Combustion Research Facility for China

CANMET designed a coal combustion research facility for the China Ministry of Energy's Thermal Power Research Institute in Xian. A scientific delegation from China, assisted by British Columbia Hydro International Ltd., selected CANMET because of its internationally recognized excellence in coal combustion research and environmental control technology.

The agreement called for CANMET to develop a conceptual design tailored to Chinese needs, provide hands-on training for Chinese scientists at CANMET, advise on extending the conceptual design to construction drawings and assist in commissioning the completed facility. The facility, which became operational in late 1990, is a key element of an energy development program funded by the Canadian International Development Agency. The Chinese have designated the project for priority funding to reduce the technological and operational risks inherent in burning coals from new mines, switching coal supplies between power plants and controlling acid rain and global warming emissions.

CANMET's work takes on special significance since China recently became the world's largest coal producer, with annual production exceeding one billion tonnes. The demand for Chinese coal is expected to increase greatly over the next decade. By using coal more cleanly and efficiently, the impact of the associated combustion source emissions on the global environment will be significantly reduced.

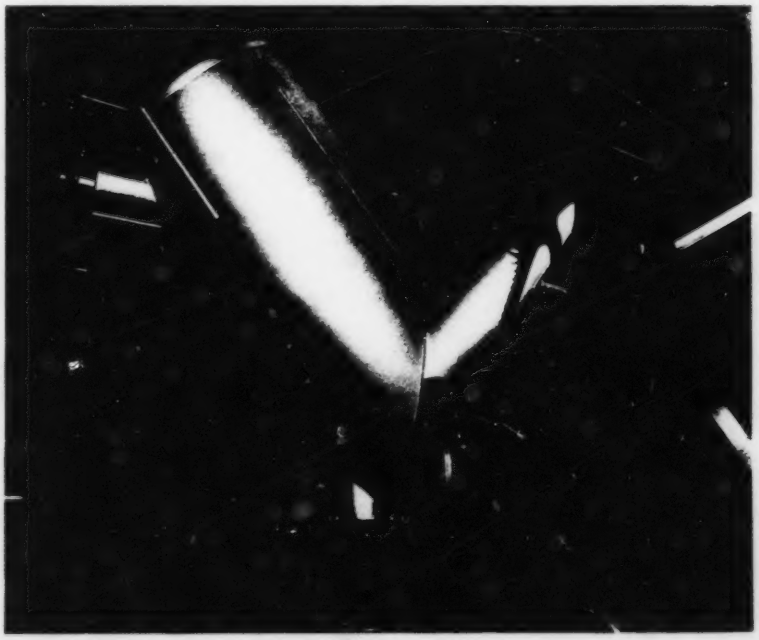
Coal-Water Slurry as Fuel

Canada and the Federal Republic of Germany completed a study on the characterization, preparation, transportation and utilization of coal-water slurry as fuel. The participating organizations were CANMET, the Alberta Office of Coal Research and Technology and Salzgitter Industrielbau AG of the Federal Republic of Germany. The $1.65-million research project was completed under a Memorandum of Understanding between the two countries.

Experimental and engineering studies using two Alberta coals were carried out by several pipeline and engineering companies over three years. CANMET beneficiated and prepared the coals for shipment to Germany where they were converted to dense coal-water slurries, using a patented technology.

The study concluded that coal-water slurry can be prepared from some Alberta coals and transported by pipeline f.o.b. to Vancouver at an estimated cost of $3.32/MJ. The cost of pipeline transportation compares very favourably with rail, and is environmentally safer in that it reduces the need for coal stockpiling. With these encouraging findings, CANMET and the Alberta government are currently exploring the formation of a consortium of Canadian producers and Canadian and international users to characterize a broader spectrum of Canadian coals (Alberta, British Columbia and some Maritime coals, as well as Saskatchewan lignites) for coal-water fuel applications.

CANMET has established an international reputation in coal combustion research.



Control of Acid Gas Emissions

CANMET recently completed a study funded by a Canadian utility company that could improve control of acid gas emissions from combustion processes. Optimizing technologies that minimize the formation of sulphur-containing gaseous products requires reliable mass balance calculations of sulphur in the fuel, ash and gas components. Existing methods for determining sulphur in liquid fuel and gaseous products do not fully apply to solid combustion residues. Previous studies that attempted to extend standard methods to these residues failed to recognize that their unique properties and morphology influenced the reliable determination of sulphur.

Through a combination of bulk and surface-sensitive analytical techniques, CANMET successfully identified and confirmed the presence of sulphur species not readily detected using existing standard techniques. These species provide valuable information concerning mechanisms of sulphur capture in coal combustors. This information has been presented to the American Society for Testing and Materials as evidence that accepted standard test methods should be modified to include solid combustion residues.

Electrocoagulation of Coal Washery Fines

CANMET, Alberta Energy, and Luscar Sterco (1977) Ltd., successfully completed a preliminary laboratory investigation of electrocoagulation. Results of the laboratory work, conducted by CANMET, provided the basis for the design and construction of a pilot-scale system that is now being tested for the same sponsors.

The technology uses an electrochemical cell with sacrificial aluminum electrodes to generate reactive ion species. These ions act to coagulate the fine particles (e.g., clays and fine coal) present in coal washery effluents. Electrocoagulation is seen as an alternative to current technologies in effluent treatment circuits with their attendant problems. The present phase of the work will also include testing on-site at the washery at Luscar Sterco's Coal Valley Plant and will provide firm economic data on the system.

MINING

New Strategies for Pillar Recovery

CANMET and Nanisivik Mines Ltd. are developing pillar recovery strategies compatible with rock mechanics in permafrost arctic mining environments. The experience gained from this project will be used to produce guidelines for pillar design and pillar mining practices in the north. These guidelines will help to improve mine safety and productivity and will lead to reduced mining costs.

Nanisivik is currently mining zinc and some lead ore from a near-surface underground mine on Baffin Island, a permafrost region. By recovering the pillars, Nanisivik hopes to increase ore extraction beyond the current 80%. CANMET conducted site investigations to determine ground stresses and geomechanical properties of the ore body and surrounding rock. CANMET also used a colour fibre-optics borehole television camera to inspect boreholes in the mine roof to check its integrity. Ground-movement monitors and CANMET strain monitors were installed at a selected site to determine ground reactions during pillar recovery. Numerical modelling was also used to evaluate overall ground stability and to determine the best sequence for mining the pillars safely and cost-effectively. Using the mining sequence recommended by CANMET, Nanisivik began mining the pillars early this year with satisfactory results to date.

In a parallel effort, CANMET and the Lupin Mine operation of Echo Bay Mines Ltd., have been collaborating on the development of artificial sill pillar design guidelines and wireless ground movement monitors.

BEAP3D Numerical Modelling Software Enhanced

CANMET and Cube Systems Consulting Services Inc. have developed new pre- and post-processing software packages for CANMET's Boundary Element Application Package (BEAP3D), a numerical modelling program for ground control and mine planning. BEAP3D was developed specifically for stress analysis of complex mine excavations. State-of-the-art pre- and post-processors facilitate the integration of numerical modelling into the mine design process. The new enhancements now place BEAP3D at the forefront of the three-dimensional mine design software packages presently available to the Canadian mining industry. An agency licence agreement to market the software nationally and internationally is currently under consideration.

CANMET is working with industry to establish limits for soot emissions from diesel equipment in underground mine air.

Procedures for Measuring Ambient Concentrations of Soot from Diesel Equipment in Underground Mines

CANMET has completed the first laboratory phase of an industry-government program to assess the quality of air in mines and improve the working environment for Canadian miners. The ultimate aim of the program is to recommend an appropriate limit for the concentration of soot from diesel equipment in underground mine air. The program was conceived by the Ad Hoc Diesel Committee, which is coordinated by CANMET and has representatives from major Canadian mining companies, three provincial inspectorates (New Brunswick, Ontario and British Columbia), as well as several manufacturers of diesel equipment.

As its contribution to the program, CANMET has completed tests in its laboratories to develop a standard protocol for measuring current soot levels. The protocol recommends sampling and analytical procedures as well as the selection and use of sampling equipment. During the second phase of the program, the participating mines will sample their underground environments using the recommended protocols to determine the current levels of ambient soot. In the final phase, the Ad Hoc Diesel Committee will examine the sampling results. Considering these data and other information on the impact of soot on health, the Committee will recommend to the industry the appropriate limit for the concentration of diesel particulates in mine air.

Laboratory Hydrofracturing of Large-Scale Rock Specimens

Working in collaboration with Atomic Energy of Canada Limited, Queen's University and the University of Wisconsin, CANMET has developed test procedures for measuring the structural behaviour of rock samples of unprecedented size. Using newly acquired computer-controlled servo-hydraulic pumps, rock samples measuring 60 cm x 120 cm were successfully hydrofractured. By working with large samples, it is possible to better simulate the behaviour of the actual rock system and to predict the behaviour of rock masses surrounding mines and potential underground nuclear waste disposal sites.

CANMET and Transport Canada have developed a biological process to neutralize toxic substances in runoff water at airports.

MINERAL PROCESSING

Mine Environment Neutral Drainage (MEND) Program

Acidic drainage is recognized as one of the foremost environmental problems facing the Canadian mining industry. The cost of reclaiming and treating non-ferrous metal mine wastes may be as high as $5 billion over the next 20 years. New technology, however, is expected to reduce this cost by as much as 80% by eliminating the need for continuous treatment after mine closures. The MEND Program was established to develop technologies to prevent and control acidic drainage. CANMET is a major participant in the five-year project, which also involves 15 Canadian mining companies, Environment Canada, Indian and Northern Affairs Canada and the provinces of British Columbia, Manitoba, Ontario, Quebec and New Brunswick.

During the year, CANMET conducted a variety of studies aimed at preventing the oxidation of sulphide minerals. For example, in partnership with Surface Science Western and Noranda Technology, CANMET studied the chemistry and mineralogy of oxidation to find ways to slow down or stop the process. In a series of experiments sponsored by Canadian mining companies, CANMET demonstrated that it was possible to electrochemically coat tailings, thus preventing oxidation.

A major project between CANMET and Rio Algom Limited involves the development of wet barriers on pyritic uranium tailings. The plan is to establish a saturated hydrologic condition at the surface of pyritic uranium tailings and to develop an appropriate wetland vegetative cover to act as an oxygen barrier that will control acid generation, stabilize the surface, and minimize surface water contamination. A 40-hectare section of Quirke Mine tailings will be used for a large-scale demonstration of the procedure. Field and laboratory investigations will run concurrently to evaluate the hydrogeochemistry of various types of wet barriers.

Neutralizing Toxic Substances in Airport Runoff

CANMET, in cooperation with Transport Canada, has developed a biological process to degrade ethylene glycol and urea in airport runoff water. Ethylene glycol is used to de-ice aircraft while urea removes ice from airport runways. Because of their toxicity in high concentrations, these substances must be treated before the runoff water can be discharged into local or municipal sewage systems. Current methods involve collecting runoff in aerated lagoons, where the ethylene glycol can break down naturally, or discharging runoff directly into the sewage system for treatment.

The CANMET process involves the addition to runoff water of a specific microorganism that degrades ethylene glycol and urea. CANMET's approach is more efficient and economical than the natural degradation option and takes up much less space. Operating parameters, such as the amount of time the runoff water is in the rotating biological contactor, can be controlled, making total removal possible. The project has been so successful that CANMET, Transport Canada, CMS Rotodisk and ORTECH International may be collaborating on a pilot plant at Pearson International Airport sponsored by Lockheed Air Terminal of Canada Inc. and several major airlines.

Improved Recoveries of Copper-Zinc by Flotation

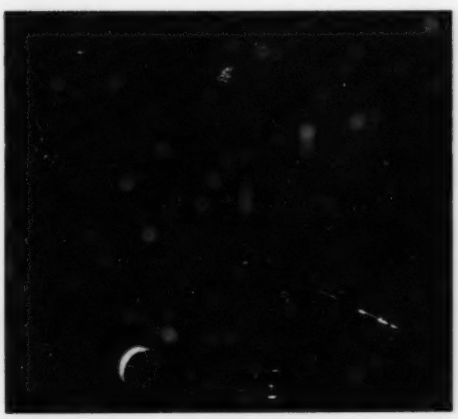
CANMET has developed a promising new technology for improving the recovery of copper and zinc by flotation as well as increasing the grade of ore concentrates. In this process, specific reagents are added to the ore during grinding to obtain a predetermined electrochemical potential value. Using copper-zinc sulphide ore samples from the Trout Lake, Manitoba ore deposit, CANMET discovered that by adjusting this potential, it is possible to increase selectivity. This resulted in improved recoveries of both copper and zinc to about 89%, up from 85% and 75% respectively, while reducing the grade of zinc in copper concentrate from an average of 5% to less than 3%. Similar improvements were obtained using an ore

from Timmins, Ontario under similar conditions. Expectations are high that this research, with the increased production it makes possible, will result in large economic gains throughout the industry.

Biodegradation of Sodium Oxalate

CANMET, Alcan International Limited and Carleton University have been collaborating on the development of a biological process that uses microorganisms to degrade sodium oxalate, an environmentally unfriendly by-product of a process for extracting alumina from bauxite ore.

In laboratory experiments carried out at CANMET, oxalate-degrading bacteria, patented by Alcan, were used in a rotating biological contactor along with a solution of sodium oxalate and other nutrients. The use of the microorganisms to degrade this substance was found to be both efficient and highly cost-effective. A pilot plant has been installed at the Alcan Refinery in Ewarton, Jamaica as a result of the laboratory work. Currently, the plant is degrading 0.2 tonnes of sodium oxalate per day.



CANMET is collaborating on the development of a microorganic process to degrade sodium oxalate, a by-product of alumina extraction from ore.

Biodegradation is economically competitive with the alternative of thermal decomposition. It is estimated that thermal decomposition would cost in excess of $300 000 per year at the Alcan plant, whereas the operating cost for the biological process is estimated at $90 000 per year. To reduce the process operating cost even further, the concentration of yeast extract in the nutrient medium is being gradually reduced and finally eliminated.

METALS AND MATERIALS

Test Methods for Predicting Expansion of Concrete

Concrete is one of the world's most important structural materials, but some concretes still suffer from cracking over the long term. Repairing cracked concrete costs millions of dollars annually. One cause of cracking is abnormal expansion resulting from reactions between certain aggregates and the alkalies in the cement.

Because cracks appear only after long service, an accelerated test would be valuable to determine susceptibility to cracking from alkaline reactivity. Aging can be accelerated by increasing the concentration of alkalies in the cement, or raising the temperature of curing.

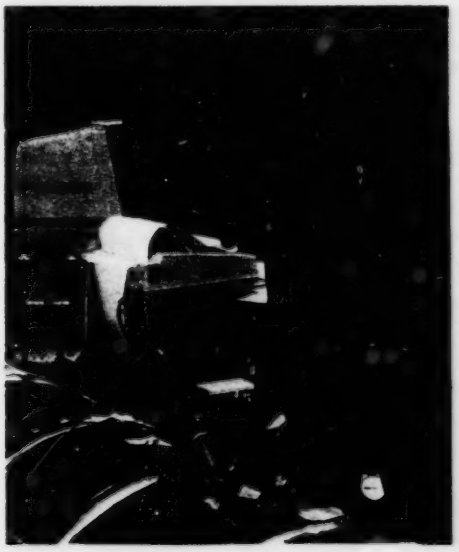
CANMET has developed, and is evaluating, several methods of studying the aging characteristics of concrete which could lead to standard accelerated tests for predicting the reactivity of aggregates and reduce long-term repair costs.

Metallizing treatments to protect steel welds on vessels and structures in the Arctic have been successfully tested at CANMET.

New Strategy to Minimize Weld-Zone Corrosion in Arctic Waters

The protection of marine vessels and offshore structures against saltwater corrosion is made more difficult in arctic waters where materials must also withstand ice abrasion. Alcan International Limited and CANMET have collaborated on exploring the use of metallizing treatments to protect steels under simulated arctic water conditions.

Both 1350 aluminum and DURALCAN 90/10 were tested as coating materials. Using flame- or arc-spraying, coatings of different thicknesses were deposited on steel test plates containing sample welds. These, together with uncoated plates, were subjected to a simulated arctic marine corrosion-abrasion test in CANMET's facility. After a six-month immersion, the uncoated test plates showed general corrosion and strong attack at either the weld metal or the heat-affected zone. The coated plates showed little evidence of attack, a consequence of the cathodic protection provided by the aluminum. Both the coatings protected the weld metal and heat-affected zone, though the aluminum 1350 showed signs of abrasive wear. Marks penned onto the surface of the DURALCAN coating were still evident after six months of immersion, a testimony to the durability of this composite coating.



Studies to evaluate the reliability of pipeline steels will be applied to enhance their performance.

Enhancing Pipeline Reliability

This year, CANMET carried out a number of projects to enhance the reliability of Canadian pipelines. Studies were conducted on a new sour service grade of pipeline steel to determine its resistance to hydrogen-induced cracking. Hydrogen is produced as a result of corrosion on the inside of pipelines that contain sour gas or oil. Some hydrogen diffuses into the steel and may cause cracking.

In the laboratory, CANMET evaluated the resistance of steel samples to hydrogen-induced cracking by immersing samples in various corrosive test solutions and evaluating the incidence of cracking using a new ultrasonic examination technique. In field trials, Amoco Canada Petroleum Company Ltd. installed a test section of sour service steel pipe at a sour gas well near Fox Creek, Alberta. In one on-site test, a corrosion inhibitor reduced hydrogen concentration on the inside pipe wall by approximately 90%. By simulating field conditions in the laboratory, CANMET is now able to evaluate pipeline steels for specific service requirements.

Higher-Quality Dental Burrs

CANMET and Beavers Dental Inc. of Morrisburg, Ontario have developed a technique to produce higher-quality dental burrs, the drill bits dentists use in drilling teeth. The procedure involves joining the cemented carbide tip of a burr to a new corrosion-resistant alloy shank. CANMET has analyzed the manufacturing procedures, investigated failures in the fabricated burrs, and made recommendations for a procedure that will produce this higher-quality product. Because of the high product volume (over 15 million units per year), Beavers Dental is currently translating these recommendations into a standard production process. Beavers Dental is the largest manufacturer of carbide dental burrs in the world.

Silicide Growth on Silicon Wafers

CANMET, in cooperation with the National Research Council Canada, entered into a cost-shared agreement with Northern Telecom to study silicide growth on silicon wafers. Silicides, which are alloys of silicon and metal, form the basis for electrical contacts in integrated circuits. The correct choice of metal depends on its reaction not only with silicon but also with electrically active dopants and other impurities.

In order to study the silicon/silicide interface in detail, a back thinning technique had to be developed to overcome the problem of metal segregation during depth profiling by secondary ion mass spectrometry (SIMS). Comparative studies carried out through SIMS revealed a dramatic improvement in the quality of depth profiles obtained with the new technique. This is the first time the technique has been used to profile dopant redistributions in silicide films on silicon. It promises to result in more accurate studies – and better integrated circuits – in the future.

Ultramicrotomy for Materials Science

Diamond knife sectioning, or ultramicrotomy, is seeing increased use as a means of producing electron microscope specimens from a wide range of materials (e.g., metals and alloys, ceramics, composites, glasses, minerals and plastics) free from the deleterious artifacts that may be produced by conventional techniques. CANMET has produced a major review of more than three decades of work on the development of this technique, including several years of collaboration with Alcan International Limited. The review, entitled *Ultramicrotomy for Materials Science*, was published by the Materials Research Society, Pittsburgh (1990). It represents a comprehensive survey of the field and points the way to further improvements and future work. Largely as a result of this work, ultramicrotomy has been included as a topic in several international workshops and courses on electron microscopy. The review has been in great demand by instrument manufacturers and research institutes throughout the world.

ENERGY EFFICIENCY AND ALTERNATIVE ENERGY

Low-Energy Copier Paper Technology

Under a cost-shared program with CANMET, Canadian Pacific Forest Products Research Limited of Hawkesbury, Ontario and Xerox Research Canada Inc. of Trois Rivières, Quebec have developed a low-energy process to substitute high-yield, stone groundwood pulp for the more expensive bleached kraft variety in the production of paper for office copiers and laser printers.

Existing electronic printing papers are made from bleached kraft pulp, a material which requires two tonnes of wood per tonne to produce, as well as substantial amounts of chemicals. In this project, a process has been developed that eliminates 85% of the kraft constituent in favour of stone groundwood pulp. The new process allows the displacement of up to 0.8 tonnes of wood and approximately two-thirds of a barrel of oil per tonne of paper produced. The new paper is slightly off-white in colour, but meets quality standards for copier and laser printer paper.

The successful outcome of the project could lead to extending mechanical pulp substitution to other grades of fine paper. In addition to reducing the quantity of wood used, the process can potentially save over a million barrels of oil annually. CANMET contributed $881 400 through the Industry Energy Research and Development Program (IERD) towards the $15.8-million project.

Technologies for pressing metal powders into precise shapes in dies have been developed with assistance from CANMET.

Powder Metallurgy

Under a cost-shared agreement with CANMET, Stackpole Limited, a Canadian company specializing in powder metallurgy processes to produce automotive components, initiated a major expansion of its Mississauga plant. Stackpole uses powder metallurgy to produce high-strength components by pressing metal powders to predetermined, very precise shapes in dies. Leading-edge technologies currently being developed under Stackpole's powder metallurgy program include alloy selection, improved densification, vacuum sintering at high temperatures, selection of rate-controlled activators, and improved heat treating using a vacuum carburizing process.

Energy savings at the plant are expected to reach the equivalent of 450 000 barrels of oil per year by 1992. By the fall of 1991, three additional bays will be added to the existing building to double its size to more than 200 000 square feet. Additional production lines will be added to increase the product mix of automotive components. The product mix includes pump components, gears, synchronizer gear assemblies, and clutch backing and pressure plates. It is now possible to produce numerous shapes in a wide range of alloys with properties comparable to conventionally produced metals. CANMET is contributing $2.8 million to the project through its Industry Energy Research and Development Program (IERD). Implementation of this project has created 250 new jobs to date.

New Extractive Fermentation Process

With support from CANMET's Bioenergy Supply Technologies Program, Queen's University has developed a fermentation process that continuously strips ethanol from the fermentation broth as it is produced. An inert liquid extracts the alcohol which is subsequently recovered. The extracting liquid is then recycled for reuse. Traditional fermentation processes have shown marginal economics for fuel ethanol production, partially as a result of alcohol toxicity and the high energy costs associated with alcohol recovery by distillation. The Extractive Fermentation Process improves overall process economics and addresses both of these concerns. It allows control of broth ethanol concentration and eliminates the need for energy-intensive distillation. The project is now approaching commercialization, and an agreement was negotiated to support further pilot-scale development and to define the terms for ownership and licensing of intellectual property.

Pilot Demonstration Unit of the Waterloo Fast Pyrolysis Process

Under a cost-shared program with CANMET, Encon Enterprises Ltd. of Calgary, Alberta constructed a mobile pilot demonstration unit that employs the University of Waterloo's fast pyrolysis process to produce pyrolytic oils and activated charcoal from peat. Pyrolytic oils are used as heating oils while activated charcoal can be used for water filtration. Over the past decade, the University of Waterloo developed a process that maximizes yields of liquids by the rapid thermal decomposition of lignocellulosic biomass, or organic waste, in a fluidized bed of sand at atmospheric pressure.

The mobile pilot demonstration unit was tested recently by Encon at a peat bog in Grand Falls, Newfoundland. The results of this project will further demonstrate the potential for biomass conversion to liquid fuels and value-added chemicals. This could be beneficial to the petroleum industry and to industries with waste feedstocks since the process breaks down waste so that it can be recycled into potentially usable products. This would reduce the need for traditional waste

disposal methods, such as landfilling, that have a negative impact on the environment. CANMET contributed $450 000 through the Bioenergy Supply Technologies Program towards the $850 000 project. Encon contributed a further $300 000 and the Newfoundland Ministry of Mines and Energy provided the remaining $100 000.

Integrated Energy Planning

CANMET established an $8-million program aimed at ensuring that the concept and benefits of integrated energy planning are clearly understood as a viable economic energy option for Canadian municipalities and that the latest technology developments are made available to foster integrated energy systems. CANMET has identified integrated energy planning as a key component in increasing Canada's energy efficiency and reducing Canada's CO_2 and acid gas emissions.

Integrated energy planning utilizes all conventional and unconventional energy sources within a community to satisfy energy demand. Some of the major technology components of an integrated energy system include cogeneration facilities to produce electricity and hot water, heat pump applications to upgrade low-grade energy sources, waste incineration, and district heating and cooling energy distribution systems.

One of the program's initial joint projects is a detailed evaluation of a new concept for district cooling in downtown Toronto that involves the use of permanently cold water (less than 4°C) from the 80-metre depth of Lake Ontario as a substitute for water currently being cooled mechanically by electric chillers. When operational, this project could displace the electricity that would normally be required for the chillers currently installed in about 500 buildings in downtown Toronto. CANMET's partners include Ontario Hydro, the Ontario ministries of Housing and Energy, and the cities of Toronto and Metropolitan Toronto, who will share equally in the $240 000 cost of the prefeasibility study.

The innovative Deep Lake Water Cooling concept would use Lake Ontario water to cool buildings in downtown Toronto.

EXPLOSIVES RESEARCH AND CERTIFICATION

CANMET is responsible for testing and certifying all explosives submitted for authorization under the *Canada Explosives Act*. Testing is conducted on every type of explosive – blasting explosives and accessories, ammunition, propellants and fireworks.

This year, CANMET initiated a project, at the request of the Royal Canadian Mounted Police (RCMP), to determine if respirators being used in training exercises involving explosives provided adequate protection against explosive fumes. Trials with these explosives confirmed high levels of some of the toxic fumes predicted by computer models. Tests on a commercial respirator filter demonstrated its effectiveness in reducing to acceptable levels one of the more significant hazards, carbon monoxide.

As part of Canada's contribution to an international R&D program to reduce bomb threats on aircraft, CANMET and Transport Canada have agreed to participate in a project to enhance the detection of specified explosives. The agreement calls for CANMET to evaluate the effects of various chemical markers which have been added to specified explosives to ensure that these marked explosives can be manufactured, stored and used safely. Other participants in this area of study include the National Research Council Canada, RCMP, Department of National Defence, ICI Explosives Canada Inc. and Produits chimiques EXPRO Inc. The results of this research will be transferred to explosives regulators and to the industry. The study should simplify the detection process and improve our capability to detect bombs and hidden explosives so that the threat and incidence of terrorist acts, particularly on commercial aircraft, can be reduced.

After six fire fighters were killed in the United States fighting an explosives fire involving a dry blasting agent containing powdered aluminum, the assumption that this type of explosive was unlikely to explode during a fire has been questioned in regulatory circles and in the industry. As a result, the Chief Inspector of Explosives asked CANMET to undertake a study of the transition from burning to detonation when blasting explosives containing aluminum are in a fire. The study's results may lead to changes in the shipping classification of some products and may guide explosives users towards products with lower explosive tendencies.

Beautiful and safe. These fireworks are among the explosives that CANMET tests and certifies under the *Canada Explosives Act*.

TECHNOLOGY DEVELOPMENT AGREEMENTS

During the year, CANMET continued to promote the involvement of industry and research organizations in technology development through numerous agreements for collaborative R&D projects. Cost- and task-shared arrangements took the form of Memoranda of Understanding (MOU), collaborative agreements, industrial consortia and Mineral Development Agreements. Technological progress resulting from these partnerships provides a competitive edge to the Canadian minerals, metals and energy industries.

WITH INDUSTRIAL PARTNERS

Development of Hydrogen-Powered Fuel Cells

CANMET signed two agreements involving the development of fuel cell technology. The first is a government-industry project to conduct field trials on hydrogen-powered fuel cell technology on an urban bus. As a member of a team that includes the Government of British Columbia and Ballard Power Systems of North Vancouver, CANMET will contribute $1 million over a 28-month period towards the project budget of about $5 million. The B.C. Ministry of Energy, Mines and Petroleum Resources and the Ministry of Advanced Education, Training and Technology will underwrite the remaining costs. The research is important to the search for environmentally friendly alternative fuels which are economically viable. The Ballard fuel cell offers up to four times the power capability of previous fuel cells, at significantly lower capital and operating costs per unit of energy output, and produces only water and heat as by-products.

The Centre also renewed a two-year agreement with Ballard Advanced Materials (a subsidiary of Ballard Power Systems), to support the development of a unique, low-cost fuel cell membrane. CANMET will provide $500 000 towards the project over two years; the company will advance $250 000. The new membrane will further improve the economic viability of fuel cell technology and increase its potential market.

R&D Cooperation with MATEX and EPRI

CANMET, MATEX Consultants Inc. of Mississauga, Ontario and the Electric Power Research Institute (EPRI) of California signed an agreement involving CANMET-developed technology for producing a high-volume fly ash concrete. This concrete, which has up to a 60% fly ash content, has mechanical properties equivalent to those of conventional concrete which contains no fly ash.

The three-year study is being conducted to develop test data on nine varieties of fly ash with the aim of generating a large data bank on fly ash concretes. The increased use of fly ash will help in energy savings and in the utilization of this waste material. Fly ash is produced in large quantities both in Canada and the United States.

Rockburst Project Receives Extension

The Canadian Rockburst Research Program Agreement, in effect until 1995, was signed to extend its predecessor, the successful five-year Canada/Ontario/Industry Rockburst Research Project. The new $10.3-million, five-year Project is aimed at improving mine design and at transferring to industry the technology for this improvement in areas prone to rockbursts, or sudden ruptures of strained rock. Improvements to mine

CANMET continues to participate in the major Rockburst initiative to improve mine design in unstable areas.

design to alleviate rockbursts, or to minimize their effects, would yield greater safety, lower costs, and enhance resource management and productivity. In this second phase of the Rockburst Project, data from seismic stations at Ontario mines and from field trials conducted by the industry, will be studied. CANMET's contribution is $600 000 annually. CANMET, the Ontario Ministry of Northern Development and Mines, the Ontario Ministry of Labour, and the Ontario mining industry, coordinated by the Ontario Mining Research Directorate, are participants in the agreement. Project members from the Ontario mining industry are Inco Limited, Falconbridge Limited, Noranda Inc., Placer Dome Inc., Brunswick Mining and Smelting Corporation Limited, Corona Corporation, Lac Minerals Ltd., Rio Algom Limited, Westmin Resources Limited, Minnova Inc. and Dickenson Mines Limited.

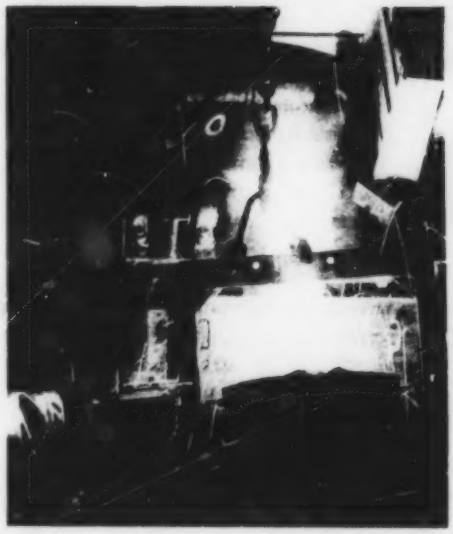
Agreement to Develop Environmental Technologies for Electric Power Industry

The Canadian Electrical Association (CEA) signed a five-year contribution agreement with CANMET under which both parties will provide expertise and funding to develop environmental technologies for fossil-fuel-fired generation of electric power. The main objective of the initiative is to promote Canada's coal industry by providing efficient, environmentally sustainable methods to produce electricity from coal. Participants will research, develop and demonstrate new technologies for electric power generation from coal, and for the reduction of emissions that contribute to acid rain and to the greenhouse effect. CANMET is contributing a maximum of $1.5 million; the CEA will provide an equal amount. CANMET, Environment Canada, the CEA and utility companies have appointed members to an advisory panel that will monitor national and international activities of relevance to this project.

Joint Research to Improve Steelmaking

Dofasco Inc. and CANMET have signed a major four-year contract in which CANMET will adapt its interactive numerical model for steel rolling to Dofasco's hot strip mill. This form of modelling is becoming popular with industry as a method of solving metal forming problems by using mathematical approaches. Dofasco will contribute approximately half of CANMET's costs of $400 000. A main objective of the research is to reduce running costs and improve plant efficiency by gaining a better understanding of the conditions required to produce steel with particular properties.

A second Dofasco-CANMET agreement valued at $1.5 million has been signed to develop a medium-strength, interstitial-free steel in uncoated and galvanized states. Each organization will cover its own costs. Interstitial-free steels are a new grade of steel popular with the automotive industry for use in body panels. Many of these steels must be galvanized to provide the corrosion resistance required by consumers.



CANMET applies its expertise in steelmaking to develop models for steel rolling and new grades of steel.

Research Consortium on Mineral Processing Control

CANMET is participating in a Canadian research and development consortium to explore applications for knowledge-based automatic control in mineral processing. The consortium is represented by mineral companies, as well as research institutes, and includes Selbaie Mines, Centre de recherches minérales du Québec, Cominco Fertilizers Potash Operations, Université Laval, Quebec Metal Mining Association, Falconbridge Limited, Quebec Cartier Mining Company, Minnova Inc., Noranda Minerals Inc., Brunswick Mining and Smelting Corp., and the Mining Industry Technology Council of Canada (MITEC). During the four-year project, advanced process control techniques will be studied via simulation for adaptability to mineral processing, particularly to the control of flotation and grinding operations. CANMET will invest $80 000 in the $900 000 project.

CANMET Supports Energy Performance Standards for Windows

CANMET, Ontario Hydro and the Ontario Ministry of Energy are funding the Canadian Standards Association in the development of an energy performance standard for windows. CANMET is contributing $20 000 to the project; the other two organizations are providing $70 000. The standard is being introduced to enable industry to participate in a voluntary window evaluation and labelling program for consumers and manufacturers. One of the program's main objectives is to encourage the production of high-performance windows which now comprise less than 10% of the market. Another goal is to provide consumers with an unbiased measure of window performance. The initial framework for the labelling program was developed during 1990 by CANMET and the Canadian Window and Door Manufacturers Association, which chaired a steering committee comprised of members from industry, user groups and regulatory boards.

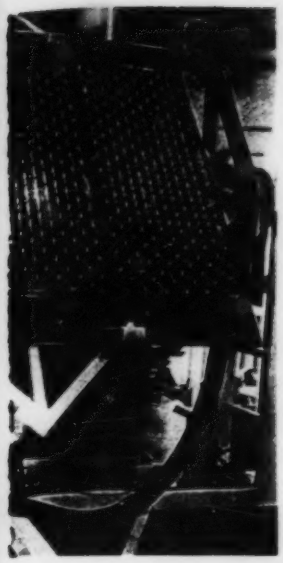
In an effort to ensure the compatibility of all North American window labelling, CANMET is coordinating its effort in the Canadian program with a similar initiative by the U.S. Department of Energy and the National Fenestration Rating Council. These two bodies are developing a window labelling program in their country which is comparable to its Canadian counterpart. Project participants include the National Research Council Canada, Queen's University, the University of Waterloo, Enermodal Engineering, the University of Massachusetts, Lawrence Berkeley Labs, Florida Solar Energy Center, ASHRAE Fenestration Committee, as well as several commercial testing laboratories.

CANMET Supports R&D to Produce Gas from Waste

CANMET, the Centre Québécois de Valorisation de la Biomasse, DISTECH R.D. Inc. and the Université de Sherbrooke signed an agreement to apply the BIOSYN process to the production of usable gas from solid municipal waste in Drummondville, Quebec. The BIOSYN process was originally developed by CANMET and Hydro-Québec to produce methanol from wood waste. CANMET will contribute $600 000 over three years to the $1.6–million effort. Turning waste into fuel would reduce the environmental impact and cost of municipal garbage disposal.

Mineral Development Agreements

Three Cooperation Agreements on Mineral Development were signed with New Brunswick, Newfoundland and Nova Scotia for five, four and two years respectively. The federal Atlantic Canada Opportunities Agency is funding the Agreements under which CANMET is responsible for delivery of the federal research and technology portions of the initiatives valued at $7 million. The Agreements will promote the mineral economies of the provinces with special emphasis on environmental concerns, competitiveness and declining base metal reserves. Negotiations are under way with other provinces and the territories for renewed agreements.



Canadian industry is encouraged to share the CANMET-supported National Solar Test Facility in Mississauga, Ontario.

WITH OTHER R&D PARTNERS

ISTC Funds CANMET Artificial Intelligence Research

CANMET has received funding of $300 000 from Industry, Science and Technology Canada to assist in the development of a sophisticated system to monitor, predict and control the properties of steel in the CANMET pilot rolling mill. A main objective of the three-year project is to provide the mill with artificial intelligence – that is, the experience gained from operating the system will be used to program the mill to control the production of steel. When adapted to commercial rolling mill conditions, the system would offer the Canadian steel industry an opportunity to significantly increase productivity and to compete effectively in the world market. CANMET will build on its previous computer modelling and related design work with Canadian steel producers to make the system a reality.

CANMET and SRC Sign MOU

The Saskatchewan Research Council (SRC) and CANMET have signed a Memorandum of Understanding (MOU) to collaborate on technology development, particularly as applied to the areas of heavy oil recovery and processing, emulsion treating and mineral processing. The first MOU project involves the enhanced recovery of heavy oil. This project offers continued progress in the economical recovery of oil from the substantial reserves of heavy oil which straddle the Saskatchewan-Alberta border. CANMET and SRC have established a joint steering committee to set objectives and priorities and to coordinate activities.

CANMET and ORTECH to Collaborate

ORTECH International has signed a two-year Memorandum of Understanding (MOU) with CANMET, marking the first time the company has undertaken a MOU with a federal agency. The two organizations will explore opportunities for joint projects in research, development and technology transfer aimed at improving industry competitiveness and productivity. As part of the MOU, prospective clients will have access to facilities in both organizations. A joint CANMET-ORTECH steering committee is coordinating the effort.

New Agreement for Solar Test Facility

ORTECH International signed a new agreement with CANMET under which ORTECH will continue to operate Canada's National Solar Test Facility (NSTF) located at the company's premises in Mississauga, Ontario. Under the agreement, ORTECH will emphasize increased operational efficiency and the promotion of additional uses for the Facility. The objective is to minimize costs by promoting the sharing of solar facilities and expertise with Canadian industry. Under the program, industry has used the facilities at NSTF to test a variety of solar products. These include SOLARWALL® technology for industrial buildings as well as windows, automobiles and photovoltaic devices for the Coast Guard.

Atlantic Wind Test Site Reorganized

CANMET and the Prince Edward Island Energy Corporation agreed to reorganize the national wind test site at North Cape, P.E.I. and to continue its operation until March 1993 in support of the Canadian Wind Energy R&D Program. At the site, Canadian and other wind energy conversion systems are tested, monitored and evaluated as part of the Program. The development of wind/diesel systems and resource assessment will be other major program elements. Annually, CANMET will contribute $300 000 to the project and the Government of Prince Edward Island will provide $100 000.

EMPLOYEE RECOGNITION

During the year, CANMET continued to gain international recognition for its work in areas such as district heating and cooling, alternative energy, and metals technology. Scientists, engineers and technicians received honours and awards from a number of professional organizations as well as from EMR for their outstanding contributions to research.

Among those honoured were several staff members who received prestigious appointments to renowned organizations both national and international.

CANMET SCIENTISTS RECEIVE AWARD OF EXCELLENCE

ANDREW STOKES, DANIEL KENNEDY and GEORGE KLINOWSKI were the recipients of the prestigious Public Service of Canada's Award of Excellence in recognition of their outstanding performance in the development of tracer gas technology to resolve complex mine ventilation problems in underground coal mines. The group's research has effected an improvement in the environmental conditions of underground mines and has had a tangible impact on the health and safety of mine workers.

Recipients of an Award of Excellence are chosen annually by the Treasury Board of Canada from among recipients of departmental Suggestion or Merit Awards. The purpose of the Award of Excellence Program is to recognize the best and most exemplary contributions to the public service resulting from suggestions or the meritorious performance of duties.

RECIPIENT	HONOUR	ORGANIZATION
William H. Erickson	Member, Board of Trustees	ASM International
William S. Bowman	Co-Chairperson	Canadian Mineral Analysts Association
John E. Dutrizac	Fellowship Award	Chemical Institute of Canada
John E. Dutrizac	Fellowship Award	Canadian Institute of Mining and Metallurgy
Ronald Molnar	Assistant Editor of *Hydrometallurgy*	Elsevier Science Publishers
Michael Wiggin	Public Service Leadership Award	International District Heating and Cooling Association
Michael Wiggin	Vice-Chairperson, Executive Committee	International Energy Agency
S. Win Lee	Chairperson, Petroleum Test Methods Committee	Canadian General Standards Board
Horace Whaley	Member, Environmental Control Division Executive Committee	American Society of Mechanical Engineers
George Lee	Fellow	China Ministry of Energy
A.C. (Skip) Hayden	Director, Source Division (reaffirmed)	Air and Waste Management Association
Ron Braaten	Chairperson	Underwriters Laboratories of Canada
Vaughn Munroe	Nova Scotia Energy Award	Nova Scotia Department of Mines and Energy
Léo Saulnier	Vice-President	International Pyrotechnics Society
Monique Carpentier	R.J. Templin Award	Canadian Wind Energy Association
Jim McGrath	Fellow	ASM International
Jean Dion Dick Warda Bob Buhr Bob Emmett Mahi Sahoo	Best Paper Award	Metallurgical Society of the Canadian Institute of Mining and Metallurgy
Keith Davis Jean-Guy Magny	Best Paper Award	American Foundrymen's Society
Andrew Stokes Daniel Kennedy George Klinowski	Award of Excellence	Public Service of Canada
Robert Thomson	Merit Award	Energy, Mines and Resources Canada (EMR)

SEMINARS, WORKSHOPS AND CONFERENCES

Every year, CANMET organizes and cosponsors seminars, workshops and conferences on a variety of topics. These events offer CANMET a forum for the transfer of new technologies to industry and for the two-way exchange of information on strategic issues affecting the future of Canada's minerals, metals and energy industries.

CANMET cosponsored the WINDSOR WORKSHOP ON ALTERNATIVE TRANSPORTATION FUELS held in Toronto, Ontario. Other sponsors were the United States Department of Energy, the Ontario Ministry of Energy, the Canadian Oxygenated Fuels Association and the Canadian Gas Association; the event was organized by ORTECH International. At the Workshop, which has been held annually since 1984, members of the transportation industry discussed developments in the utilization of alternative fuels and environmental concerns. More than 300 participants learned about natural gas and methanol use for vehicles, heavy-duty vehicle engines, diesel engine emissions control and the economics and infrastructure of alternative transportation fuels in North America. Attendance at this event, which attracted participants from nine countries, increased by 10% over that of the 1989 workshop.

CANMET collaborated in cosponsoring a CONFÉRENCE NEDEM : COLLOQUE SUR LA RÉDUCTION ET LE DRAINAGE DES EFFLUENTS ACIDES GÉNÉRÉS PAR LES ACTIVITÉS MINIÈRES. Other sponsors of the event, which was held in Val d'Or, Quebec, were the Centre de recherches minérales and l'Association minière du Québec, inc. Half of the one-day seminar focused on the prevention and control of acidic mine drainage at Quebec sites and the Quebec laws affecting such drainage programs; the other half was given over to topics of general interest. These included the modelling of the long-term effects of such drainage, software prediction procedures for determining whether a site will become acidic, microbiological treatment of acidic drainage and the introduction of vegetation to tailing sites. The seminar attracted 140 participants from both Ontario and Quebec.

A symposium held in Toronto, Ontario on TRANSPORTATION FUELS AND THE ENVIRONMENTAL CHALLENGES attracted more than 100 industry representatives from across Canada. The event was organized by CANMET which also cosponsored it in conjunction with the Canadian Petroleum Products Institute. Presentations and discussions by speakers from the Canadian and American fuel and car industries and from the Canadian government focused on CANMET's role in developing transportation fuels to meet stronger environmental guidelines, and on new fuels characteristics, their impact on the environment, problems for refiners and possible solutions.

Reverse osmosis and ultrafiltration were the topics of discussion at a CANMET-sponsored and -organized workshop on the FUNDAMENTALS OF MEMBRANE TECHNOLOGY AND WASTEWATER TREATMENT. The two-day meeting was held in Edmonton, Alberta. More than 40 representatives from the Alberta and federal governments, the Canadian and American oil industries and Canadian universities attended. The workshop offered an opportunity for discussion of industry problems and possible technological solutions in the economical treatment of process water from heavy oil and oil sands. Reverse osmosis and ultrafiltration offer alternative techniques for the removal of fine particles from this water. This cleansing is necessary to prepare the water for

reuse in oil field steam generation and for the protection of the environment.

The Metallurgical Society of the Canadian Institute of Mining and Metallurgy sponsored the INTERNATIONAL SYMPOSIUM ON THE MATHEMATICAL MODELLING OF THE HOT ROLLING OF STEEL at the 29th Annual Conference of Metallurgists in Hamilton, Ontario. About 100 people from a dozen European, Far Eastern, North American and South American countries attended the Symposium which was organized by CANMET, Stelco Steel, McGill University and the University of British Columbia. Papers and discussions focused on the application of mathematical modelling to permit precise control of the quality and mechanical properties of steel produced by hot rolling. Due to economics and the need for higher quality, tolerances for this steel are continually being made more stringent. The Symposium provided a forum for the exchange of expertise and a chance for North American industry to consider the advantages of steel rolling models which have yet to gain acceptance here at the production level.

CANMET sponsored a special conference in Ottawa, Ontario on STRESSES IN UNDERGROUND STRUCTURES. The conference, which attracted 80 registrants from the mining industry in Canada, the United States and Australia, featured presentations on the determination of ground stresses, modelling of stress fields and recent developments in monitoring. The two-day conference featured a special technology transfer session by Denison-Potacan Potash Company of Sussex, New Brunswick, on the support provided by potash salt waste when it is returned to mined-out underground openings.

SEMINARS, WORKSHOPS AND CONFERENCES

NAME	COSPONSORS	LOCATION	DATE
Fourth International Wind-Diesel Workshop	American Wind Energy Association, Canadian Wind Energy Association	Montréal, Que.	May 1990
International Workshop on Alkali-Aggregate Reactions in Concrete	Institute for Research in Construction (National Research Council Canada), Atlantic Chapter (Halifax) of the American Concrete Institute	Halifax, N.S.	May 1990
The Chemistry of Surfaces and Advanced Materials	Chemical Institute of Canada	Edmonton, Alta.	May 1990
Colloid Chemistry Training Course	Alberta Oil Sands Technology and Research Authority (AOSTRA)	Kananaskis, Alta.	May 1990
Quality Engineering		Ottawa, Ont.	May 1990
Metals Technology Development for New Markets at the Annual General Meeting of the Canadian Institute of Mining and Metallurgy	Canadian Institute of Mining and Metallurgy	Ottawa, Ont.	May 1990
Metal Matrix Composites Workshop		Ottawa, Ont.	May 1990
Window Design Tools Seminar at the Annual Meeting of the Canadian Window and Door Manufacturers Association		Vancouver, B.C.	May 1990
Non-Ferrous Casting Technology	American Foundrymen's Society, Inc.	Edmonton, Alta. Vancouver, B.C.	May 1990
Techniques for Materials Characterization at the Canadian Materials Science Conference	Canadian Materials Science Conference	Kingston, Ont.	June 1990
Corrosion Colloquium on Feasible Cathodic Protection to Result in Durable Underground Steel Tank Systems		Hamilton, Ont.	June 1990
Joint Technical Workshop on Coprocessing	U.S. Department of Energy	Ottawa, Ont.	June 1990
Workshop on Computer-Assisted Mineral Processing	University of British Columbia	Vancouver, B.C.	June 1990

NAME	COSPONSORS	LOCATION	DATE
International Symposium/Workshop on Future Ironmaking Processes	Stelco Technical Services Ltd., Algoma Steel Corporation Limited, Canadian Carbonization Research Association, Canadian Liquid Air Ltd., Canadian Steel Industry Research Association, Iron Ore Company of Canada, Linde Division of Union Carbide Canada Limited, National Slag Limited, Ontario Hydro, Steico Inc., Union Gas	Hamilton, Ont.	June 1990
Sustainable Energy Choices for the '90s at the 16th Annual Conference of the Solar Energy Society of Canada	Solar Energy Society of Canada Inc., N.S. Department of Mines and Energy, Solar Nova Scotia, Canadian Photovoltaic Industries Association, Canadian Solar Industries Association Inc.	Halifax, N.S.	June 1990
Windsor Workshop on Alternative Transportation Fuels	U.S. Department of Energy, Ontario Ministry of Energy, Canadian Oxygenated Fuels Association, Canadian Gas Association	Toronto, Ont.	June 1990
Fundamentals of Membrane Technology and Wastewater Treatment		Edmonton, Alta.	June 1990
The Eighth International Passive and Low Energy Architecture (PLEA) Conference	N.S. Department of Mines and Energy, N.S. Association of Architects, N.S. Power Corporation, Technical University of Nova Scotia, Solar Energy Society of Canada Inc., Canadian Airlines International Ltd., Canadian Home Builders Association, Capital Insulation and Ventilation Systems Ltd., Social Sciences and Humanities Research Council of Canada	Halifax, N.S.	June 1990
Energy Efficiency Beyond Frontiers in support of the International Energy Agency's Centre for the Analysis and Dissemination of Demonstrated Energy Technologies (CADDET) Programs		Varennes, Que.	June 1990
Fifth International Conference on Indoor Air Quality and Climate	Alberta Environmental Centre, Canada Mortgage and Housing Corporation, Canadian Gas Association, Centre for Indoor Air Research, Health and Welfare Canada, Institut de recherche en santé et en sécurité du travail du Québec, National Research Council Canada, Public Works Canada, U.S. Department of Energy, U.S. Electric Power Research Institute, U.S. Environmental Protection Agency, U.S. Gas Research Institute	Toronto, Ont.	July 1990

NAME	COSPONSORS	LOCATION	DATE
North Atlantic Treaty Organization Conference on Energy and Building Sciences in Indoor Air Quality	Public Works Canada, Canada Mortgage and Housing Corporation, Institut de recherche en santé et en sécurité du travail du Québec	Ste-Adèle, Que.	August 1990
International Symposium on the Mathematical Modelling of the Hot Rolling of Steel	Metallurgical Society of the Canadian Institute of Mining and Metallurgy, Stelco Steel, McGill University, University of British Columbia	Hamilton, Ont.	August 1990
International Workshop on Fly Ash in Concrete	Institute for Research in Construction (National Research Council Canada), Electric Power Research Institute	Calgary, Alta.	October 1990
Stresses in Underground Structures		Ottawa, Ont.	October 1990
Workshop on Boundary Element Application Package		Ottawa, Ont.	October 1990
Contractors Workshop on Biomass Liquefaction		Ottawa, Ont.	October 1990
Technology Transfer Session on Energy Efficient Industrial Boilers at Canadian Forces Base St. Hubert	Department of National Defence, Weishaupt Canada	St. Hubert, Que.	November 1990
Workshop on Emerging Technologies for Metal and Metallurgical Processing	ORTECH International, Ontario Ministry of Energy, University of Toronto	Toronto, Ont.	November 1990
Conférence NEDEM : Colloque sur la réduction et le drainage des effluents acides générés par les activités minières	Centre de recherches minérales, NEDEM Québec	Val d'Or, Que.	November 1990
Transportation Fuels and the Environmental Challenges	Canadian Petroleum Products Institute	Toronto, Ont.	November 1990
Sunshine Workshop on Crystalline Silicon Solar Cells	Members of the International Photovoltaic Energy Project	Shizuoka, Japan	November 1990
Workshop for Small and Commercial Sized Boiler Manufacturers	Ensyn Engineering Associates Inc.	Halifax, N.S.	February 1991
Small Woodlot Woodchipping Practices	P.E.I. Energy Corporation	Charlottetown, P.E.I.	February 1991
Energy and the Environment		Toronto, Ont.	March 1991
The Fifteenth Annual Conference on Energy from Biomass and Wastes	U.S. Department of Energy, Institute of Gas Technology	Washington, D.C.	March 1991
Conférence sur l'énergie et l'environnement	Association québécoise pour la maîtrise de l'énergie	Montréal, Que.	March 1991

SECONDMENTS

Each year, CANMET arranges numerous secondments, or personnel exchanges, to and from industry and international organizations. These transfers are among the many methods employed by CANMET to accomplish the free flow of the latest developments in technology to industry. During the year, Centre personnel participated in personnel exchanges with the following companies and industry organizations:

SECONDMENTS TO CANMET FROM INDUSTRY AND OTHER ORGANIZATIONS

- Joseph Lau from Atomic Energy of Canada Limited
- Annette Roach from Rio Algom Limited
- Connie Caldwell, Debbie Horne, Henry Jurgens and Dan de Chevigny from Denison Mines Limited
- Anthony Kingsley from the Canadian Electrical Association
- Sudharshu Varda from BM Hi-Tech Inc.
- Guy Lauzier from Les Mines Aurizon, supported by a Mineral Development Agreement
- Hiromichi Shimada from the National Chemical Laboratory for Industry, Japan
- Sum Rui Jun from Shanghai Energy Research Institute, China
- Eddy Chui from Advanced Scientific Computing Ltd.
- Naoto Kinbara from Sumitomo Metal Mining Company, Japan
- Stephan Sicars, on executive exchange from Forschungszentrum für Kaltetechnik und Warmspumpen (GmbH), Germany
- Sundaran Kumar from Ceramics Kingston
- Hang Li and Swati Chakavarty from Hawker Siddeley Canada Inc.
- A.S. (Gopi) Hargopal of the Indian Bureau of Mines, India
- Robert Hall from Syncrude Canada Ltd.

CANMET SECONDMENTS TO INDUSTRY AND OTHER ORGANIZATIONS

- Ahmed Salama to Syncrude Canada Ltd.
- W. Doug Gould to the Fermentation Research Institute (a government-industry research laboratory), Japan
- Robert Philp to the Canadian Electrical Association
- Ben Anthony to CERCHAR, France
- Eric Estwick to Calian Inc.
- Kelly Thambimuthu to International Energy Agency Coal Research, England
- Dick Warda to QIT-Fer et Titane Inc.
- Alain Couture to National Institute of Magnesium Technology

UNIVERSITY SECONDMENTS TO CANMET

- SHENGZAO CHEN from the People's Republic of China, on a post-doctoral fellowship sponsored by the National Research Council Canada
- BIRUBI BIMAN from Laurentian University
- LINDA TREMBLAY from Université Laval, sponsored by Lac Minerals Ltd.

CANMET SECONDMENTS TO UNIVERSITIES

- DANIEL LAGUITTON and BLAISE LABRECQUE to Université Laval

MINISTER'S NATIONAL ADVISORY COUNCIL TO CANMET

The Minister's National Advisory Council to CANMET (MNACC) is an industry-led advisory board reporting to the Minister of Energy, Mines and Resources. MNACC provides strategic guidance to CANMET on the Centre's R&D programs and on management and policy issues. As a major link between CANMET and its industrial clients, MNACC promotes technology transfer and helps to ensure that CANMET programs are relevant to the needs of industry.

MNACC is supported by six technical committees and one business committee. Members of Council and its committees are senior representatives of Canadian industry, industrial associations, provincial research organizations and universities. These members provide informed opinions based on their broad experience and knowledge.

On Council's recommendation, the Honourable Jake Epp, Minister of Energy, Mines and Resources, added an Efficiency and Alternative Energy Committee to MNACC in 1990. The Committee will review the work of CANMET's new Efficiency and Alternative Energy Technology Branch. Council also recommended that the new Energy Diversification Research Laboratory at Varennes, Quebec, should focus on non-conventional energy generation and utilization technologies – areas which it considers to be of long-term, strategic importance to Canada.

In endorsing the CANMET Business Plan for 1991-94, Council noted CANMET's rapidly growing partnership with Canadian industry, as evidenced by this report. CANMET is continually strengthening its ability to serve its industrial clients in a number of ways; one of these is its growing network with other research organizations.

In the words of the Council Chairperson, Peter Tarassoff:

Canada's minerals, metals and energy industries are fortunate in having a national research and development laboratory like CANMET. Council encourages more Canadian companies, large and small, to take advantage of CANMET's broad expertise and its cost-sharing programs in improving their competitiveness.

MINISTER'S NATIONAL ADVISORY COUNCIL TO CANMET

PETER TARASSOFF
Vice-President and Chief Scientist
Noranda Inc.
Chairperson, The Council

ED BARRY
Vice-President, Environment and Research
TransAlta Utilities Corporation
Chairperson, Business Committee

GERALD LETHBRIDGE
Vice-President, Engineering and Production
Nova Scotia Power Corporation
Chairperson, Coal Committee

ALAN PELMAN
President and Chief Executive Officer
Powertech Labs Inc.
Chairperson, Efficiency and Alternative Energy Committee

DAVID M. MOORE
Technical Director
Alcan International Limited
Chairperson, Metals and Materials Committee

JACQUES NANTEL
Manager, Environment and Mining Laboratory
Noranda Technology Centre
Chairperson, Mining Committee

J.A.E. (SANDY) BELL
Director, Product Research
Inco Limited
Chairperson, Mineral Processing Committee

RICHARD LEA
Manager of Technology
Shell Canada Limited
Chairperson, Oil and Gas Committee

(From left) PETER TARASSOFF, Chairperson, Minister's National Advisory Council to CANMET (MNACC), with the Honourable JAKE EPP, Minister of Energy, Mines and Resources, and THANE WALDI, Chairperson Designate for MNACC for 1992.

FINANCIAL PROFILE 1990-91

SUB-ACTIVITY	PERSON-YEARS	CAPITAL ($000)	OPERATING & SALARIES ($000)	TOTAL BUDGET ($000)
Mineral and Energy Technology:				
Mining and Explosives Research	89	769	7 162	7 931
Coal and Oil Sands Mining and Preparation	60	680	6 506	7 186
Mineral Processing	174	1 619	14 008	15 627
Fuels Technology	166	1 737	18 309	20 046
Metals and Materials	125	1 365	9 457	10 822
Technology Marketing and Information Services	44	124	4 432	4 556
Efficiency and Alternative Energy	61	1 017	18 075	19 092
Administration of the *Canada Explosives Act*	28	63	1 702	1 765
Technical Services	51	240	3 354	3 594
Management and Support	52	371	6 492	6 863
Total	**850**	**7 985**	**89 497**	**97 482**

Note: The total of Operating and Salaries includes $20.1 million in R&D contracts and excludes $6.6 million in employee benefits which are not paid directly by the Mineral and Energy Technology Sector.

FUNDING FROM THE ENERGY R&D PROGRAM

CANMET obtains substantial funding from the Energy Research and Development Program. The interdepartmental federal Program promotes the development of science and technology that diversifies and sustains the sources, production and application of energy in Canada. This Program, which is administered by the Office of Energy Research and Development of Energy, Mines and Resources Canada, also supports research that expands environmental protection. In 1990-91, CANMET received $49 million and 120 person-years in support from the Program.

COST RECOVERY

Revenues from cost-recovery projects are directed to the Consolidated Revenue Fund.

SOURCE	1988-89 ($000)	1989-90 ($000)	1990-91 ($000)
Other Government Departments	48	285	287
Outside Parties	2 217	4 398	5 300
Total	**2 265**	**4 683**	**5 587**

R&D CONTRACTS MANAGED BY CANMET

Including participation of industry and other agencies.

FUNDING SOURCE	1988-89 ($000)	1989-90 ($000)	1990-91* ($000)
CANMET	11 964	12 957	20 086
Industry	4 430	8 018	11 331
Supply and Services Canada Bridge Funding	1 815	970	67
Other Government Departments	287	470	370
Provincial Governments	14	88	822
Total	**18 510**	**22 503**	**32 676**

* Reflects the addition of the Efficiency and Alternative Energy Technology Branch to CANMET.

SIGNED JOINT R&D PROJECTS

	1988-89 ($000)	1989-90 ($000)	1990-91 ($000)
CANMET Contribution	3 200	7 514	8 729
Partner Contribution	6 000	8 731	14 091
Total	**9 200**	**16 245**	**22 820**

CANMET FACILITIES AND SERVICES

Oil and Gas

- heavy oil and bitumen hydroprocessing plant
- pilot-scale hydrotreaters
- catalyst preparation facilities
- catalyst testing facilities
- coal-oil coprocessing plant
- fuel analyses
- electron microscopy
- surface analyses
- oil furnaces
- chemical characterization of fuels
- gamma ray instrumentation for hydrodynamic studies

Coal

- utility boiler and fluidized bed furnaces
- equipment for coke making and testing
- coal preparation plant
- mobile water treatment plant
- mobile dewatering plant
- coal-oil coprocessing pilot plant
- analyses of fuels
- electron microscopy
- surface analyses
- electrocoagulation pilot plant

Mining

- static and dynamic characterization of rock and rock mass testing
- mine backfill testing
- borehole instrumentation (rock mechanics)
- certification and testing of explosion-proof equipment
- certification and testing of fire-resistant materials
- X-ray analysis equipment to detect silica in mine dust
- tracer gas assessment for mine air flows
- ventilation and dust instrumentation calibration
- National Radon and Thoron Test Facility
- radiation instrument calibration
- mining technology information
- gas and dust explosibility determination
- diesel emissions investigation
- mine environment monitoring equipment and expertise

Mineral Processing

- environmental services
- image analysis system
- flotation column
- mineral dressing and extractive metallurgy development facilities
- computer simulation/modelling
- thermochemical analyses
- sensors development
- mineralogical characterization
- analytical method development
- certified reference materials
- concrete testing
- characterization of ceramic materials

Metals and Materials

- pilot-scale foundry
- rolling mill
- wire drawing facilities
- corrosion test equipment
- welding and forming simulators
- wear testing facilities
- analyses of metals
- mechanical testing
- electron microscopy
- surface analyses

Explosives

- explosives testing facility
- ammunitions testing facility
- analyses of explosives
- thermal hazard evaluation of energetic materials
- non-destructive testing of explosives articles
- fireworks testing
- determination of properties of explosives

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